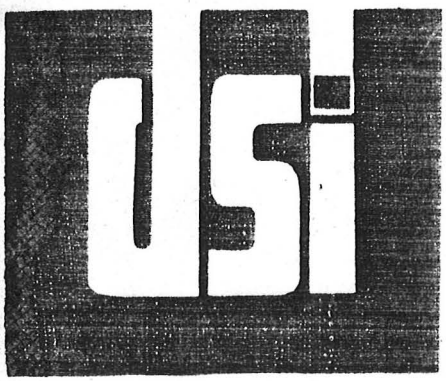
INSTRUCTION MANUAL

REPEATER
AUTO PATCH
MODEL RAP-200



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SPECIFICATIONS

INPUT LEVEL FROM RECEIVER:	-25 DB to +12 dB
RECEIVER INPUT IMPEDANCE:	600 ohms, AC coupled transformer
OUTPUT TO TRANSMITTER:	-20 dB to + 0 dB, adjustable
TRANSMITTER OUTPUT IMPEDANCE:	600 ohms, AC coupled transformer
INPUT LEVEL FROM TELEPHONE:	-30 dB to +4 dB
OUTPUT LEVEL TO TELEPHONE:	-30 dB to 0 dB, adjustable
OFF-HOOK AND TRANS-MITTER PTT RELAY:	SPDT relay: Contact rating 250 Vdc, 3000 mA, 300 Va. 90 watts or whichever is greater
TIME-OUT TIMER:	30 seconds to 3 minutes, adjustable, COR resetable
CONTROL INPUT:	Ground or positive voltage from receiver COR circuit
POWER:	Rack Mount: 117 Vac, 50-60 Hertz P. C. Board: 12 Vdc, 125 mA
TEMPERATURE:	-20°C to +70° operating -50°C to +115° storage
HUMIDITY:	0 to 95% non-condensing
DIMENSIONS:	P. C. Board: 3/4" x 4 1/2" x 9" HWD Rack Mount: 3 1/2" x 19" x 19" HWD
WEIGHT:	P. C. Board: 10 oz., Sh. Wt. 2 lbs. Rack Mount: 6 lbs., Sh. Wt. 8 lbs.

SECTION 1.0

GENERAL DESCRIPTION

1.1 The DATA SIGNAL, INC. Model RAP-200 Repeater Auto Patch is a completely self-contained solid-state interconnect unit that provides for automatic interfacing of mobile or portable transceivers into the telephone system. The RAP-200 is used in commercial radio common carrier, government and private radio telephone systems where reliable automatic telephone interconnect is required. Half duplex radio repeater, simplex mobile or portable radio, systems can be accommodated by the RAP-200.

1.2 The RAP-200 makes use of an optimum combination of linear and complementary metal oxide semiconductor (CMOS) integrated circuit as well as discrete devices to achieve high reliability and flexibility.

1.3 The RAP-200 is available in a printed circuit board or rack mount version. The printed circuit board is 4.5" x 9" x 1/2", HWD, and requires a standard Cinch-Jones 251-50-44A-30 or equivalent double row socket for installation. The rack mount unit contains a built-in AC power supply and all the necessary connections to allow for simple installation. The unit requires at least 3.5" of vertical rack space of a standard 19" rack. All signal and power connections are via a rear panel terminal strip.

1.4 Operation of the RAP-200 is straight forward. A remote user wishing to place a call must transmit the Touch-Tone** digit *. The RAP-200, upon receiving the digit * will go "off hook" and connect the repeater system to the telephone. The remote, after hearing the dial tone, will proceed to send the telephone number to the phone system. In those cases where a touch-tone line is not available, the RAP-200 must be complemented by the DATA SIGNAL DPC-221, Touch-Tone to Dial Pulse Converter. Upon connection, conversation from the remote to the calling party will proceed on a half-duplex basis. Half-duplex in this case means that the remote is operating on a push-to-talk (PTT) basis. The remote may terminate the call by sending the digit "#" whereupon the RAP-200 will go "on-hook". A timer is provided to automatically disconnect the RAP-200 when a carrier is not detected for a pre-determined period of time.

** TM of A.T.& T.

1.5 A standard feature of the RAP-200 is its capability to allow a party at a telephone to dial the RAP-200. The RAP-200, upon detection of the ring signal, will key the repeater transmitter and send a short call tone. This tone goes out to all mobiles listening. Any mobile may then come back and answer the telephone at the site by sending the digit *. Conversation then proceeds on a normal basis. Selective calling will be made available as an option in the near future.

1.6 Telephone compatibility is built into the RAP-200. All telephone interface connections are brought out separately to the rear of the unit. By the use of rear panel strapping, compatibility can be achieved with most telephone company provided couplers, or directly to private telephone systems.

SECTION 2.0

INSTALLATION

2.1 RECEIVING INSPECTION

2.2 The RAP-200 has been carefully packed for shipment. Upon receipt of the unit, it should be thoroughly examined for evidence of physical damage. Examine the rack enclosure exterior for dents, etc. and internally to insure that the printed circuit board and power supplies are firmly bolted down and the board is properly seated within its socket. Remove any packing material, fuses or paperwork that may have been placed inside the unit. Any exterior and/or interior damage noted should be reported immediately to the shipper so that a damage claim, if applicable, may be filed with the carrier.

2.3 MOUNTING

2.4 The RAP-200 may be mounted in any standard 19" wide rack. At least 3.5" of vertical rack space will be necessary. The enclosure dimensions are 3.5" x 19" x 9", HWD. Four machine screws will be required to bolt the rack enclosure to the rack.

2.5 The RAP-200 rack requires 117 Vac. @ 60 Hertz for correct operation. The AC line cord provided is a three-conductor type with the ground conductor connected to the chassis ground. For warranty and safety purposes, DO NOT clip the third prong of the AC line cord to accommodate the old style two prong AC receptacle. If a two wire receptacle is only available, use an adapter plug and connect the green wire of the adapter to a suitable earth ground.

2.7 ELECTRICAL CONNECTIONS

2.8 The RAP-200 printed circuit board is designed to mate with a standard 22/44 pin printed circuit board edge connector such as the Cinch-Jones #251-50-44A-30 or its equivalent. All electrical connections to the RAP-200 electronics are via this edge connector.

2.9 All external electrical connections to and from the RAP-200 rack are made via the rear panel. Mounted on the rear panel is a 25 lug terminal block which provides all signal inputs and outputs.

2.10 The 22/44 pin edge connector is numbered from one to 22 on the top, or component side of the board, and from A to Z; G, I, O and Q omitted, on the bottom, or solder side of the board. The various edge connector pins of the RAP-200 that are routed to the 25 lug terminal block on the rear of the unit are used for installation purposes and are discussed in the following paragraph.

2.11 RAP-200 REPEATER INTER-CONNECTIONS, RACK MOUNT

2.12 Connections between the RAP-200 rack and the radio repeater are shown in Figure 2.1. An explanation of each connection is discussed below as well as the different options available with the connection.

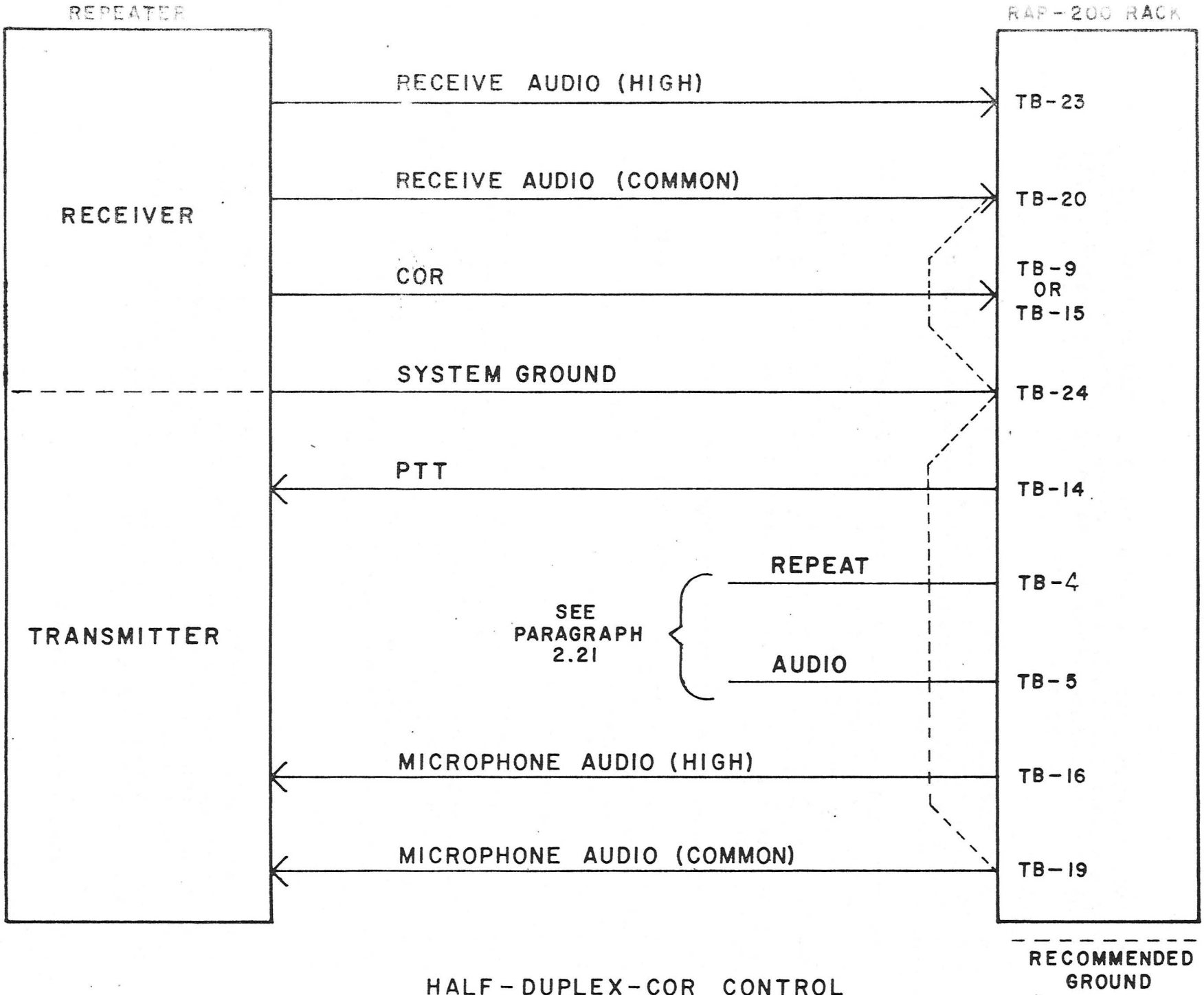
2.13 REPEATER RECEIVER AUDIO

2.14 The input audio from the repeater receiver should be connected to TB-20 and TB-21. The input impedance of the RAP-200 is 600 ohms. If a higher impedance, 47K ohm is required, the receiver should be connected between TB20 and TB23. The input is transformer coupled and can be balanced or unbalanced. If it is required that an unbalanced line be available, it is recommended that TB20 be connected to ground. The capacitor between TB21 and TB20 is used if DC is present on the input audio signal.

2.15 COR INPUT

2.16 When using the RAP-200 it is required that a COR input be available. This input allows the time-out timer to reset and provide control of the telephone's audio. When the COR output from the receiver is a ground, it must be connected to TB9. However, if the output is a positive voltage, 5 or 12 Vdc, the COR input must be connected to TB15.

2.17 TRANSMITTER PTT INPUT



HALF-DUPLEX-COR CONTROL
FIGURE 2.1

2.18 When in the automatic interconnect mode, the RAP-200 controls the associated repeater's transmitter. Once the patch has been accessed by the remote user, a ground is placed onto TB14. This ground is used to key the repeater transmitter.

2.19 TRANSMITTER MICROPHONE INPUT

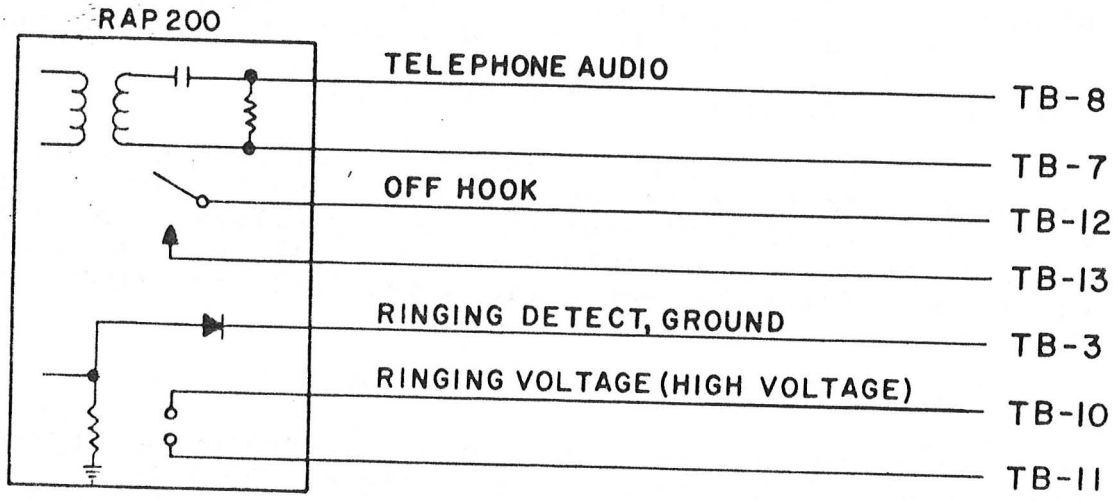
2.20 The output audio from the RAP-200 is available from TB18 and TB19. The output impedance is 600 ohms. If a higher impedance, 47K ohm, is required, use TB19 and TB16. The output is transformer coupled and can be balanced or unbalanced. If it is required that an unbalanced line be available it is recommended that TB19 be connected to ground. The capacitor between TB17 and TB18 is used if DC is present on the transmitter audio input.

2.21 REPEATER REPEAT AUDIO

2.22 The normal function of a repeater is to apply the incoming receiver audio to the transmitter microphone input. However, when an automatic interconnect package is added to the repeater system this audio path is normally opened during the duration of the interconnect call. A set of normally closed contacts have been provided at TB4 and TB5 and remain closed until the RAP-200 is accessed. These contacts can be used to open the audio path between the receiver and transmitter, if desired, during the interconnect call.

2.23 RAP-200 TELEPHONE INTERFACE, RACK MOUNT

2.24 Connection between the RAP-200 and the telephone interface are shown in Figure 2.2. An explanation of each connection is discussed below as well as the different options available with the connection.



TELEPHONE INTERFACE CONNECTIONS
FIGURE 2.2

2.25 TELEPHONE COUPLING TRANSFORMER

2.26 Terminals TB7 and TB8 connect to the telephone coupling transformer and holding circuit in RAP-200. These are connected to the telephone interface and provide a nominal 600-900 ohms impedance to the phone line plus DC loop closure when the RAP-200 is off-hook. All audio to and from the phone line is via these two terminals.

2.27 OFF-HOOK RELAY

2.28 The normally open off-hook relay of the patch appears at terminals TB12 and TB13. These contacts will close when an off-hook condition occurs within the RAP-200. This closure is routed to the phone line or coupler to signal an off-hook condition to the central office.

2.29 DIAL-OUT HIGH VOLTAGE INPUT

2.30 The dial-out input, once activated, allows the RAP-200 to alert all mobiles that an incoming call from the landline is occuring. The high voltage AC ringing signal from the telephone line is connected to terminals TB10 and TB11.

2.31 DIAL-OUT EXTERNAL GROUND INPUT

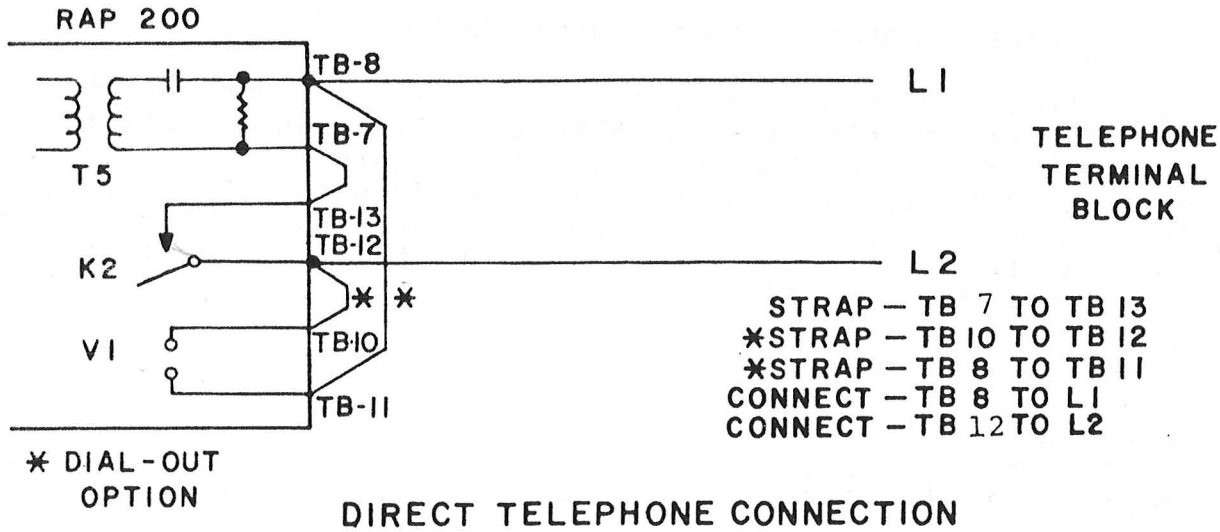
2.32 This dial-out function is the same as that discussed in Paragraph 2.29. Control of the dial-out function, however, is also possible by placing a ground onto terminal TB3. This terminal is useful when no high voltage ringing signal is available, such as is the case when using the SU6-AQ coupler.

2.33 RAP-200/TELEPHONE INTER-CONNECTIONS

2.34 The RAP-200 has been designed to allowed external strapping to accommodate the many types of telephone company provided couplers. The RAP-200 also has the capability to be connected directly to private telephone systems. Illustrations of several of the many inter-connect options available are shown in Figures 2.3, 2.4 and 2.5.

2.35 DIRECT TELEPHONE LINE CONNECTION

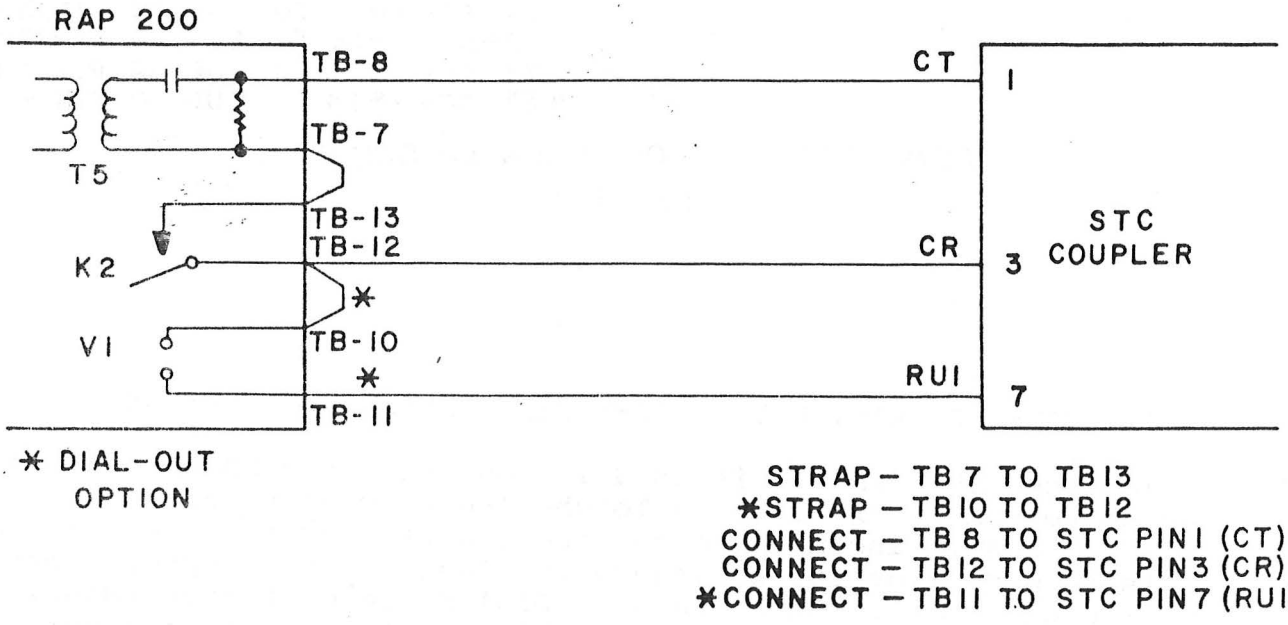
2.36 Where it is permissable on private telephone systems, the RAP-200 can be connected directly to the telephone line. Figure 2.3 illustrates the connections between the RAP-200 and the telephone company provided telephone block.



DIRECT TELEPHONE CONNECTION
FIGURE 2.3

2.37 VOICE CONNECTING ARRANGEMENT STC

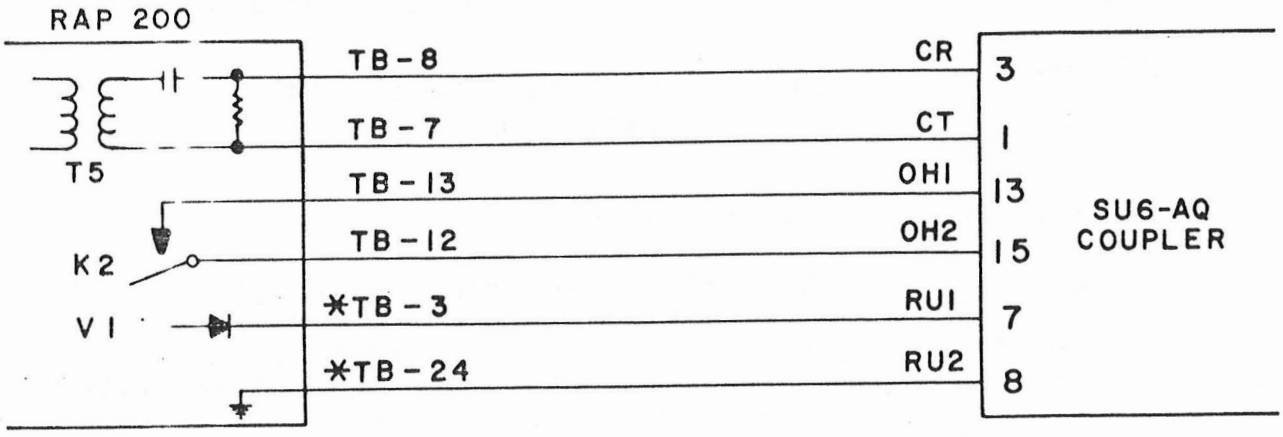
2.38 One type of coupler obtainable from the telephone company is their Model STC. This voice connecting arrangement is readily available and has the advantage of being fairly easy to connect. The dial-out arrangement of the RAP-200 is compatible with the STC. Figure 2.4 illustrates the connection between the RAP-200 and telephone company provided STC coupler.



CONNECTION THROUGH STC COUPLER
FIGURE 2.4

2.39 VOICE CONNECTING ARRANGEMENT SU6-AQ

2.40 Voice connecting arrangement SU6-AQ is a coupler which is fully compatible with the RAP-200. Dial-out capability is provided by use of a relay contact within the SU6-AQ. This coupler requires more connections than does the STC, however, it is also fairly easy to connect. Figure 2.5 illustrates the connections between the RAP-200 and the telephone company provided SU6-AQ coupler.



* DIAL-OUT OPTION

STRAP-TB 8 TO SU6-AQ PIN 3 (CR)
STRAP-TB 7 TO SU6-AQ PIN 1 (CT)
STRAP-TB 13 TO SU6-AQ PIN 13 (OH-1)
STRAP-TB 12 TO SU6-AQ PIN 15 (OH-2)
* STRAP-TB 3 TO SU6-AQ PIN 7 (RU1)
* STRAP-TB 24 TO SU6-AQ PIN 8 (RU2)

CONNECTION THROUGH SU6-AQ COUPLER
FIGURE 2.5

2.41 COMPATABILITY WITH ROTARY DIAL TELEPHONE EXCHANGE

2.42 When the RAP-200 is used in conjunction with a rotary dial pulse telephone exchange, a Touch-Tone to Dial Pulse Converter must be used. Incoming touch tone digits are converted to dial pulses to provide the necessary pulsing of the telephone central office equipment. DATA SIGNAL'S Dial Pulse Convertor, Model DPC-221, is required to perform this function. Connection of the DPC-221R to the RAP-200 is shown in Figures 2.6 and 2.7. Figure 2.6 is applicable in most cases, however, the configuration shown in Figure 2.7 is required when using the SU6-AQ coupler.

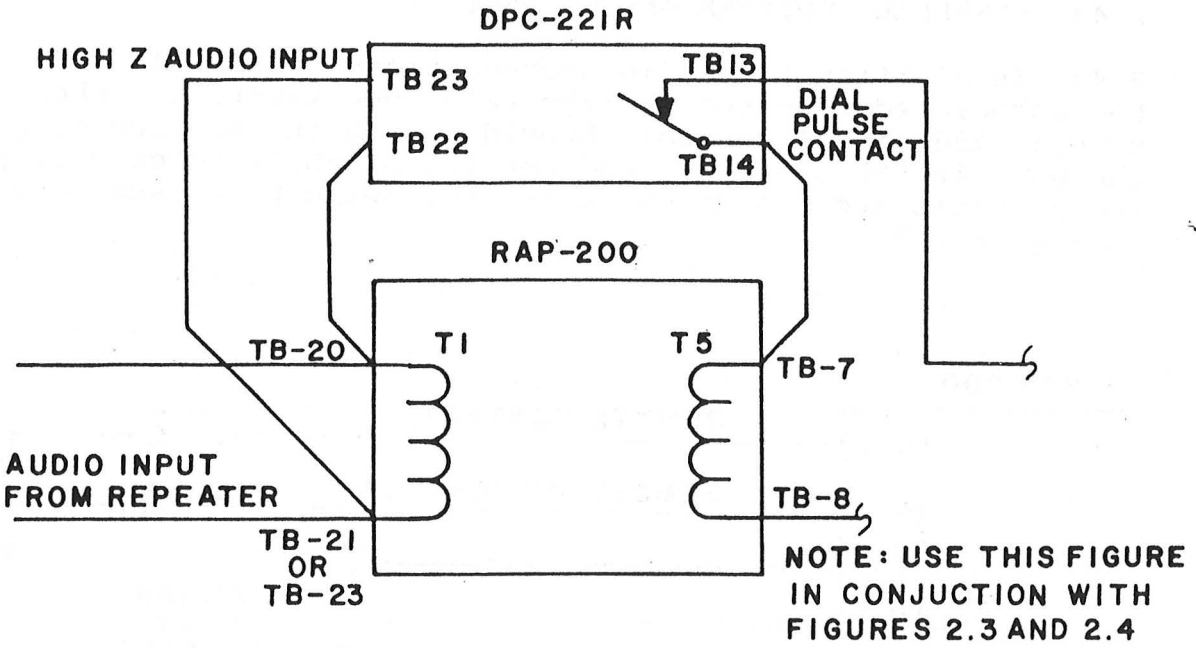


FIGURE 2.6

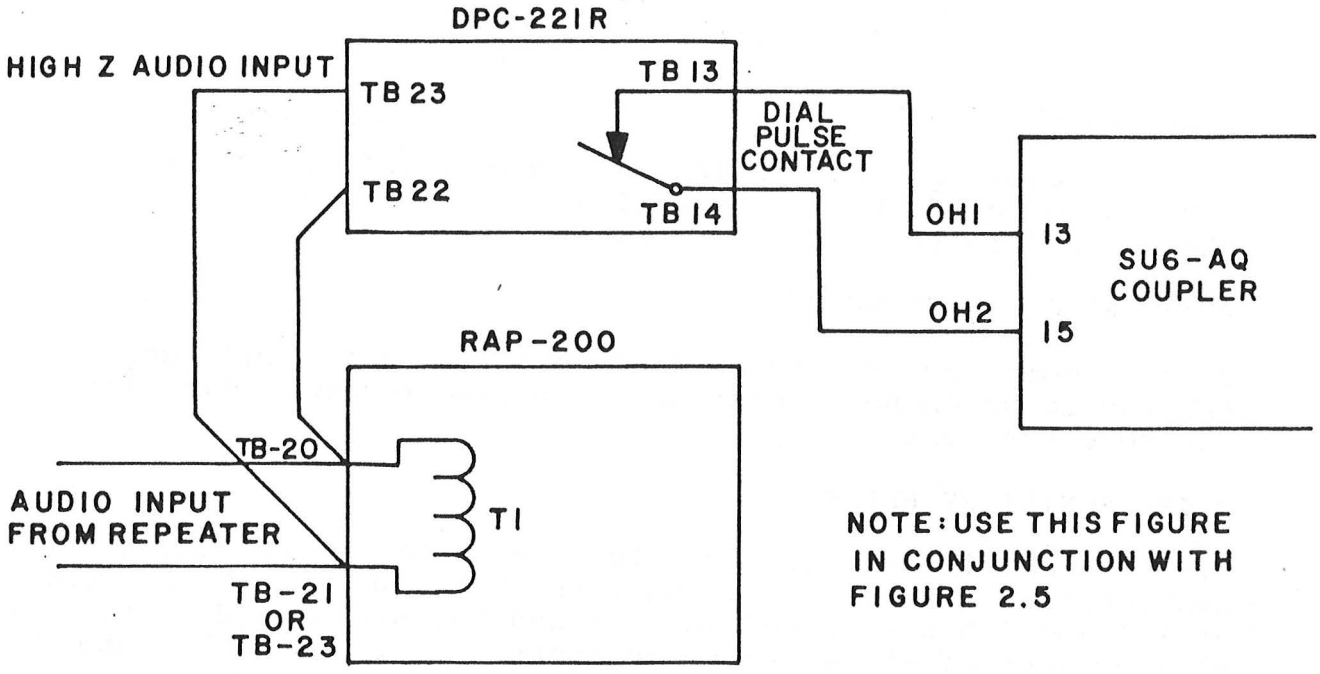
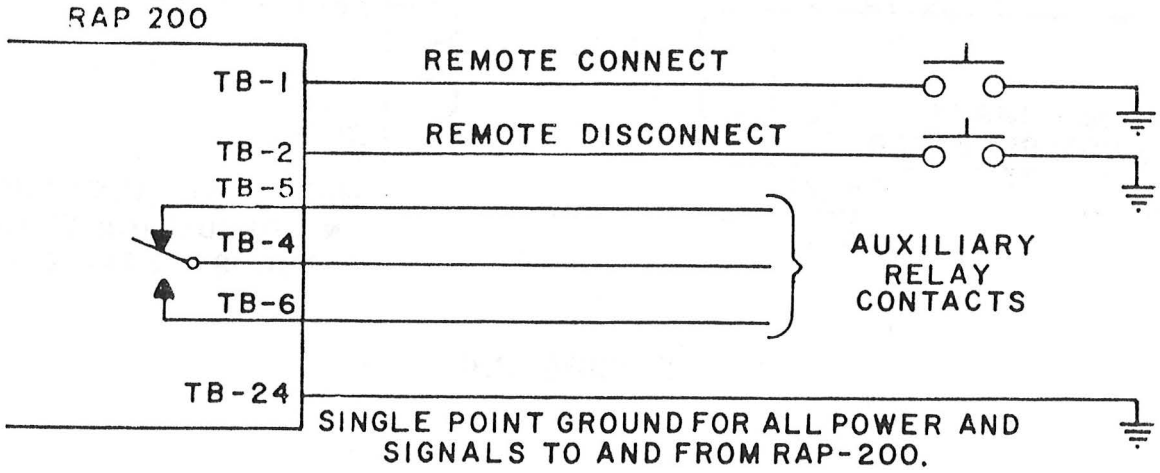


FIGURE 2.7

2.43 EXTERNAL CONTROLS AND CONNECTIONS

2.44 In addition to the interconnections of the RAP-200 between the associated repeater and the telephone interface, there are several additional controls provided with the RAP-200 to assist the user in the operation and control of the interconnect package. The controls are discussed in the following paragraphs and shown in Figure 2.8.



EXTERNAL CONTROLS
FIGURE 2.8

2.45 REMOTE CONNECT

2.46 A remote ground applied to terminal TB1 will cause the RAP-200 to go off-hook, connecting the telephone line through the RAP-200 to the repeater system.

2.47 REMOTE DISCONNECT

2.48 A momentary ground applied to terminal TB2 will cause the RAP-200 to go on-hook, disconnecting the telephone line from the repeater system.

2.49 AUXILIARY RELAY

2.50 The auxiliary relay single pole double throw contacts are available at TB4, 5 and 6. When the RAP-200 is on-hook, contacts at TB4 and TB5 are closed and TB4 and TB6 are opened. When the RAP-200 goes off-hook, these contacts will reverse; TB4 and TB5 are opened, and TB4 and TB6 are closed.

2.51 SINGLE POINT GROUND

2.52 Terminal TB24 is the common ground and is used to provide a single point ground for all microphone, receiver audio and other signals to and from the RAP-200. Chassis and power supply ground is also connected to TB24.

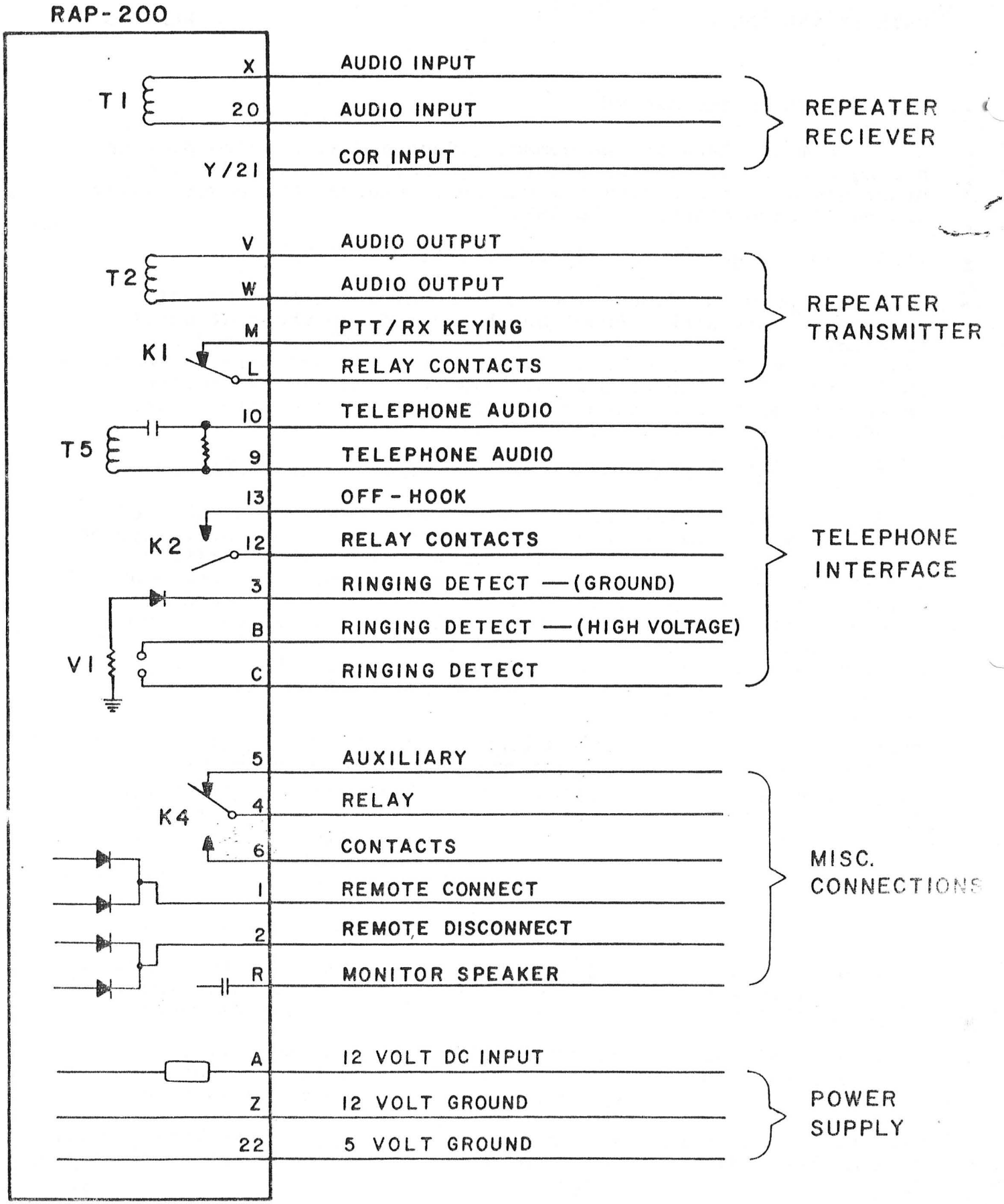
2.53 CONNECTING THE RAP-200 PRINTED CIRCUIT BOARD

2.54 The previous discussions have referred to the RAP-200 rack mount unit with connections being made to the rear panel terminal lugs of the rack enclosure. Connections to aid the user in installation of the printed circuit board only is shown in Figure 2.9. Reference should also be made to the previous paragraphs of this section and to Figure 7.1 Schematic Diagram and Figure 7.3 RAP-200R wiring diagram.

2.55 ADJUSTMENT OF INTERNAL CONTROLS PRIOR TO INSTALLATION

2.56 All internal variable resistors have been pre-calibrated and adjusted at the factory for operation into a SU6-AQ telephone coupler and with a standard half-duplex repeater transmitter receiver combination. However, due to the many variables that exist from one installation to another, the user may need to make several slight adjustments for his specific installation. In this case, a listing, along with an explanation of each adjustment is provided below. It is recommended that no adjustments be made without referring to Section 5.0 on Test and Section 6.0 on Alignment.

CONTROL	FUNCTION	COMMENTS
Variable Resistor R1 Input Audio Adjust	Control audio level to telephone line	Adjust only if audio level into telephone line is not proper. Factory adjusted for typical phone line.May vary from phone line at user's location.
Variable Resistor R2 Touch-Tone decoder audio input level	Adjust audio level to Touch-Tone decoders	May require adjustment. Dependent on input audio level from receiver.
Variable Resistor R3 monitor speaker Level	Adjust level of internal monitor speaker	Adjust only if volume of monitor speaker does not suit users taste.
Variable Resistor R4 Transmitter Audio Input	Adjust level of audio to transmitter	Adjust for proper amount of audio to transmitter.



RAP-200
PRINTED CIRCUIT BOARD VARIOUS CONNECTIONS
FIGURE 2.9

CONTROL	FUNCTION	COMMENTS
Variable Resistor R5 Dial-Out Oscillator Output	Adjust audio level from dial-out oscillator to input of microphone amplifier	Adjust only if dial-out oscillator output to transmitter is improper. Factory adjusted for typical transmitter audio input.
Variable Resistor R6 Touch-Tone Digit Validation	Adjust length of time digit must be received prior to verification as correct digit	Adjust only if validation needs changing. Adjustment not recommended.
Validation Resistor R7 Time Out Timer	Adjust length of time patch remains off-hook upon removal of COR input	Adjust only if time out is to be other than 30 seconds.
Variable Resistor R8-10 Tone Decode Frequency Adjustment	Adjust each decoder to appropriate frequency	Should not require adjustment by user.

SECTION 3.0

OPERATING INSTRUCTIONS

3.1 GENERAL

3.2 The RAP-200 can be easily integrated into various system designs using many different repeater and telephone interface configurations. Input tone levels from any source are acceptable as long as the tones are of sufficient level and quality to allow the tone decoders to properly decode and provide a suitable signal to the telephone line.

3.3 The response time of the applicable radio system and the RAP-200 must be considered while accessing and disconnecting the interconnect unit. If a dial pulse converter is used, the response time of these units must be considered. When an automatic high speed dialer is used, adjust its output speed to allow for the validation timing of applicable tone decoders, i.e. dial pulse converter. In radio systems it is important to

remember that the first digit in a sequence must be sent longer than the remaining sequence if the tone and the transmitter is keyed at the same time. The first digit will not be received by the RAP-200 until after the transmitter has had time to reach full power and break the receiver squelch. Delaying the complete dialing sequence approximately a second until full power has occured is recommended.

3.4 When the RAP-200 is connected to a new Touch-Tone line, be sure that the line provided is in fact a Touch-Tone line.

3.5 When the RAP-200 is connected to a dial pulse line, be sure that the line provided is not capable of operating with Touch Tone signalling.

3.6 If the local telephone exchange is not a dial pulse exchange, do not request that the telephone company add a dial pulse converter to provide Touch-Tone service. Instead, add the dial pulse converter at the repeater site. DATA SIGNAL'S Model DPC-221 is recommended. NOTE: The DPC-221 is more forgiving than the telephone company provided dial pulse converters.

SECTION 4.0

CIRCUIT DESCRIPTION

4.1 GENERAL

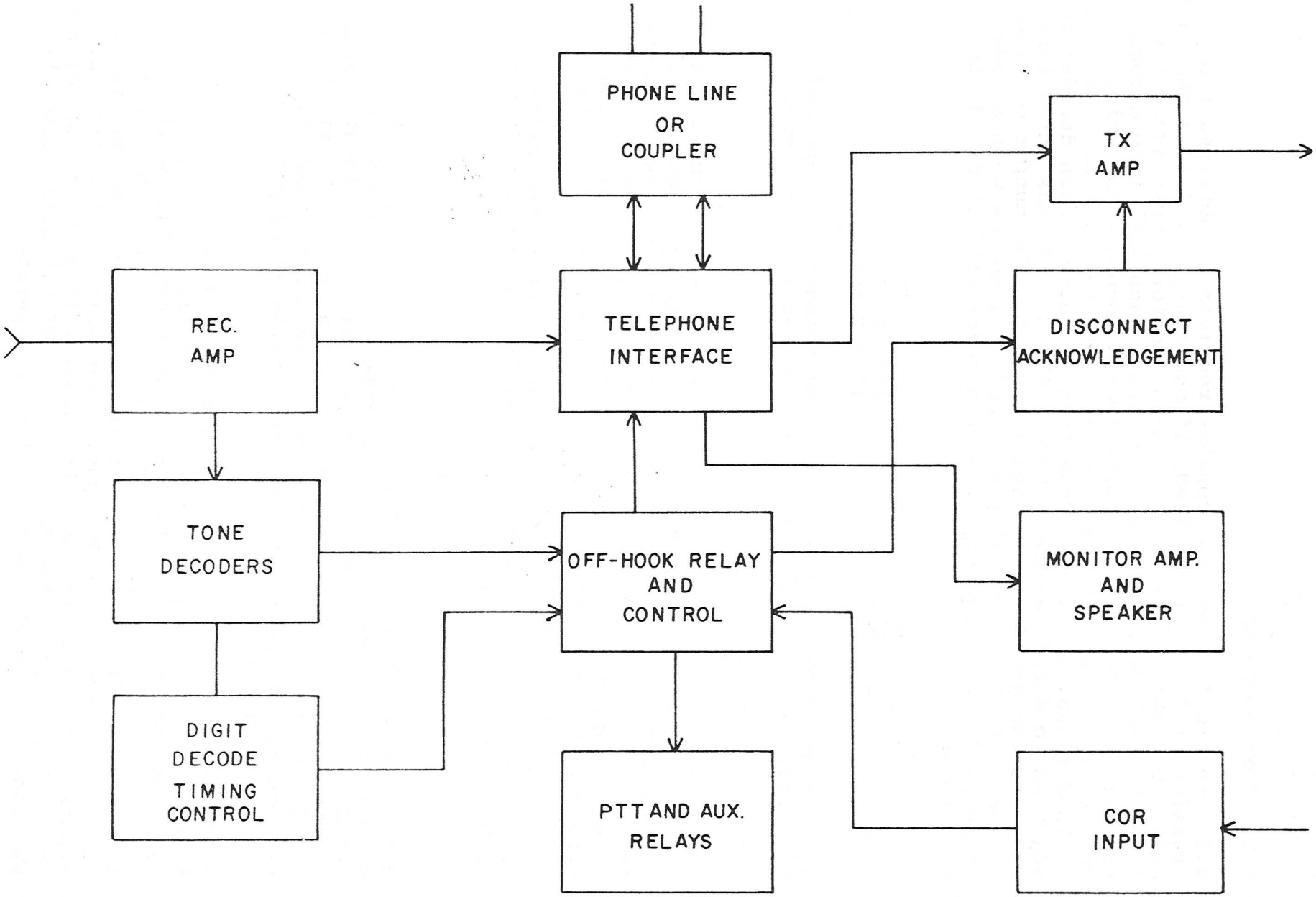
4.2 The RAP-200 is composed of a mix of digital and analog circuits. These circuits are broken out by their individual functions in order to facilitate understanding of the internal operation of the unit. Figure 4.1,Simplified Block Diagram, and Figure 7.1, Schematic Diagram, are used as a guide during the following circuit description.

4.3 RECEIVER INPUT AUDIO

4.4 Audio output from the repeater receiver is connected to the input terminals TB20,and TB21, 22 or 23. Audio input is fed directly into the primary of transformer T1. If the incoming audio has a DC component, an external capacitor must be added to prevent the applied DC voltage from saturating the coil of T1, therefore requiring the use of TB22 or TB23.

4.5 REPEATER RECEIVER TO PHONE LINE AUDIO

4.6 The input audio to the telephone line is controlled by variable resistor R1. The mobile audio is applied to transformer T1 and amplified by audio amplifier Q1. The output of the audio amplifier Q1 is via transformer T3. T3 directly feeds the telephone coupling transformer T5.



RAP-200
FUNCTIONAL BLOCK DIAGRAM

4.7 TONE DECODERS

4.8 The audio from the repeater receiver is obtained from transformer T1 and is limited, if necessary, by diodes CR17 and CR18. Variable resistor R2 is adjusted for proper audio level into the bank of three tone decoders. Each dual tone decoder consists of a solid-state phase locked loop decoder which inherently has a high degree of immunity to false signals, out of band signals, and high rejection to noise. Each decoder is adjusted to decode a single tone. The RAP-200 has three tone decoders for decoding the digits * and #. The output of each decoder, pin 8, is normally high and will go low when a tone is decoded. The frequency of each decoder used to decode the dual tones are:

U9	-	697 Hertz
U10	-	1477 Hertz
U11	-	1209 Hertz

The outputs from the individual tone decoders are applied to the digit decoders, timing control and validation logic.

4.9 DIGIT VALIDATION

4.10 Validation of the RAP-200 control digit is controlled by the U8 timer. When the * or # digit is being decoded by the tone decoders, the output, Pin 8, of U9 will be low. Whenever Pin 8 of U9 goes low, transistor Q9 will stop conducting and allow a high to appear at Pin 2 of U8. Additionally, the ground from Pin 6 and Pin 7 will be removed to allow C15 to charge. When Q9 stops conducting, validation timing starts. If, at any time during the validation process, the clamp is re-applied, C15 will be discharged. The instant validation occurs, Pin 3 of U8 will go low.

4.11 CONNECT, OFF-HOOK CONDITION

4.12 The RAP-200, when in the connect mode, allows the telephone interface to be connected to the repeater. Two modes of connections are possible; automatic and manual. The automatic mode is accomplished by receipt of the digit * along with activation of the COR input. Manual connection is accomplished by depressing the front panel connect button or by placing a momentary ground onto TB1.

4.13 The dual tones for the * are 941 and 1209 Hertz. These tones are decoded by U9 and U11. Validation will be initiated by U8 at the release of the U8 timing clamp, Q9. While validation is in process, U7C Pins 11and 12 will be low as well as Pin 4 of U7B. Pin 4 of U7B is low due to a low on Pins 2 and 5 of U5 from the COR input. When validation occurs, all inputs on U7C will be low, its output will go high and set the U6C/U7B flip-flop. The high at Pin 6 of U7B will cause the auxiliary, off-hook and PTT relays to operate.

4.14 Manual connect is performed by a ground being applied via CR1 and CR2 to the input of U7C. The operation of the manual connect function is identical to the automatic connect function from the time the ground is applied to the input of U7C, until off-hook occurs.

4.15 TIME OUT TIMER

4.16 The time out timer or automatic disconnect timer function is performed by U5 and controlled by the COR input.

4.17 COR INPUT

4.18 The COR, better known as the carrier operated relay, input, to the RAP-200 can be obtained from two sources. A positive voltage, a relay contact or a transistor, being switched to ground or the same being switched from ground to a positive 5 or 12 Vdc. If the COR switches to ground, TB-9 is used to connect the COR to the RAP-200. The ground via diode CR12 places a low onto resistor R48. If the COR switches to positive voltage TB15is used to connect the COR to the RAP-200. The voltage allows Q7 to conduct and a low is placed onto resistor R48.

4.19 NOTE: If a positive voltage to ground is used to switch the COR input it must be at least positive 12 Vdc. to ground. A positive 5 Vdc. to ground will not allow diode CR12 to fully turn off.

4.20 TIME OUT TIMER

4.21 The time out timer or automatic disconnect timer function is performed by U5. The timing function of U5 is initiated when the COR input is closed. This allows a low at Pin 2 to trigger the U5 timer, however, the low at CR15 prevents the timer from timing. When the COR circuit is released the low clamp is removed from CR15 and the timer starts to time. Timing continues until time out occurs, or the low is re-applied and capacitor C38 discharged. Timing we see, therefore, is that time interval when the remote user is not talking. The interval is normally set for 30 to 45 seconds. Once timeout occurs, a high appears at Pin 4 of U7B via U6D and resets the U6C/U7B off-hook flip-flop.

4.22 DISCONNECT, ON-HOOK CONDITION

4.23 The RAP-200, when in the disconnect mode, allows the telephone interface to be disconnected from the repeater. Two modes of disconnect are possible, automatic or manual. The automatic mode is accomplished by the receipt of the digit #. Manual disconnect is accomplished by depressing the front panel disconnect button or by placing a momentary ground onto TB2.

4.24 The dual tones for the #, 941 and 1477 Hertz. These tones are decoded by U9 and U10. Validation will be initiated by U8. While validation is in process, U7A Pins 1 and 2 will be low. When validation occurs, all three inputs of U7A will be low. Pin 9 of U7A will go high and reset the U6C/U7B off-hook flip flop. The RAP-200 will now be disconnected.

4.25 Manual disconnect is performed by a ground being applied via CR3 and CR4 to the input of U7A. The operation of the manual disconnect function is identical to the automatic disconnect function from the time the ground is applied to the input of U7A, until on-hook occurs.

4.26 TELEPHONE AUDIO CLAMP

4.27 The RAP-200 is designed so that no mobile audio can be injected into the phone system immediately following the off-hook access sequence, that is, until the * has been received and terminated. This is accomplished by relay K3, the audio switching relay, which inhibits mobile audio to the phone line. Relay K3 is controlled by the COR input--only after the second COR operation of a mobile interconnect call. The first operation of the COR input allows the U5 timer to be triggered plus the discharging of capacitor C32 via diode CR5. At this time a low is applied to Pin 6 of U1B via the COR input and a low is applied to Pin 2 of U1A. The audio clamp flip flop U1A/U1B will set--that is, U1B, Pin 4 will go low for a short time interval, C32 and R52 timing, following the removal of the COR input. Pin 6 of U6B via U1C and U1D will be low for the duration of the interconnect call. The second operation of the COR input, number dialing to start, will see a low at Pin 5 of U6B along with the low at Pin 6. The base of Q8 will be high causing the release of K3, thus switching the inbound audio to the telephone line.

4.28 MOBILE AUDIO TO TELEPHONE

4.29 The audio from the repeater is coupled to the RAP-200 via transformer T1. Audio amplifier Q1 amplifies the mobile audio into transformer T3. The output of T3 is coupled via the K3 relay to the telephone coupling transformer, T5. The path between transformers T3 and T5 will be opened whenever the COR input is open. The path will be closed, however, each time the COR input is made, that is, after the access code is received. The audio level to the phone line is controlled by the setting of variable resistor R1.

4.30 PHONE LINE AUDIO TO REPEATER

4.31 The audio from the telephone line is applied to transformer T5, and in turn to the input of audio amplifier Q2 via the relay contacts of K3. Audio amplifier Q2 amplifies the telephone audio into transformer T2. The output of T2 is coupled directly to the input of the repeater's transmitter. The path between transformer T5 and audio amplifier Q2 will be open whenever the COR input is made. The path will be closed, however, each time the COR input is open. The audio level to the transmitter is controlled by the setting of variable resistor R4.

4.32 DIAL OUT AUDIO TO REPEATER

4.33 Dial out audio from the dial out oscillator, see Paragraph 4.34, is controlled by R5.

4.34 ACKNOWLEDGMENT TRANSPONDER AUDIO TO REPEATER

4.35 Acknowledgment transponder audio from the dial out oscillator, see Paragraph 4.32, is controlled by R5.

4.36 MONITOR SPEAKER

4.37 The RAP-200 monitor speaker presents both sides of the conversation to the user. The speaker may be switched off via a switch located on the rear of the RAP-200. Adjust variable resistor R3 for the desired level.

4.38 TELEPHONE INTERCONNECT INTERFACE

4.39 The telephone interface of the RAP-200 is designed for maximum reliability and allows for easy interface to the various phone company couplers or directly to phone lines of private telephone systems. The main components of the interface are: The telephone audio coupling transformer, the holding circuit, the off-hook relay and the ring detect oscillator. Each of these components are discussed below. Additional information can be found in Section 2.0.

4.40 TELEPHONE AUDIO COUPLING

4.41 The telephone audio coupling consists of a standard audio transformer,an 820 ohm resistor, and a non-polar 4 mfd. capacitor. The unit presents approximately 600 to 900 ohm impedance.to the telephone line. All incoming and outgoing audio from the phone system is via the coupling transformer which is switched to the input/output of the repeater via audio switching relay K3.

4.42 HOLDING CIRCUIT

4.43 HC1 is a telephone holding circuit and consists of a standard one watt 820 ohm resistor. This resistor presents the proper DC resistance to the phone company when the RAP-200 goes off-hook. HC1 is across the coupling transformer on the DC side. The holding circuit and coupling transformer are brought out to terminal block TB7 and TB8.

4.44 OFF-HOOK RELAY

4.45 K2 is the off-hook relay. Its normally-open contact and wiper are routed to TB12 and TB13 for appropriate strapping to the phone system as shown in Section 2.0. When the RAP-200 goes off hook, these contacts will close.

4.46 RING DETECT, DIAL OUT

4.47 LC1 is a neon lamp cell. This cell can detect the high voltage AC ringing signal from the phone system. The ringing voltage is applied between terminal block TB10 and TB11. In series with the neon cell is a 47K ohm resistor to limit current. When a ringing signal is impressed across the cell, the internal neon lamp will light and cause the internal resistor to change resistance. When the neon is out, the resistance is approximately 15 meg. ohms. When a ring is detected, this resistance drops to 1.5K ohms. This causes the voltage at R37 to drop and a low to be applied to Pin 8 of U3C and Pin 12 of U3D.

4.48 Whenever,the output of Pin 10 of U3C is low, the ring detect oscillator will run,.Two modes of operation is possible in the RAP-200, one is to allow the oscillator to run only for a short tone burst or for as long as the incoming phone is ringing. Strap A determines which mode of operation the RAP-200 is in. See Figure 7.3 for the location of the A strap. When the A strap is removed U3D is prevented from functioning. U3C, therefore, will follow its Pin 8 input and allow the oscillator to ring continuously. When the A strap is in use, R25 is connected to ground, allowing U3D to function. Pin 11 of U3D will, therefore, allow C25 to charge and apply a delayed high to Pin 9 of U3C. When the high is applied to Pin 3 U3C will be clamped and the oscillator will stop ringing, even if the incoming phone is still ringing.

4.49 As soon as a ring is detected, Pin 4 of U4B will go low allowing U4C/U4D oscillator to function and to energize relay K1 via Q6. K1, the PTT relay, will key the repeater transmitter and allow the tones to be transmitted via transformer T2.

4.50 DISCONNECT ACKNOWLEDGMENT TRANSPONDER

4.51 The disconnect acknowledgment transponder is available within the RAP-200 to provide the user a tone acknowledgment whenever the interconnect unit is disconnected from the phone line. This tone will provide the user a positive assurance that disconnect has occured. The collector of Q4 is at a low

whenever the unit is in an off-hook condition. When an on-hook occurs, capacitor C22 will charge and apply a short high pulse to the U3A/U3B pulser. The pulse is now armed, however, diode CR18 maintains a low on Pin 6 of U4B preventing the oscillator from running. Diode CR19 prevents the pulser from initiating its timing cycle. The two diode clamps are maintained until the input COR is removed. U4B, Pin 4 will go low and allow the U4D and U4C oscillator to run for the duration of the pulse provided at Pin 6 of U4B. The function of the oscillator and the PTT relay is the same as discussed in Paragraph 4.48.

4.52 STRAP B

4.53 Strap B is removed only when it is desired to deactivate the * access code. This feature is used when the MDA-200 multi-digit access option is added to the RAP-200.

4.54 STRAP C

4.55 Strap C is added only when the unit is used with the DATA SIGNAL provided RTC-2 voice coupler. The option provides for the removal of LC1 and the addition of Q10. For complete details, see the installation manual for the RTC-2 voice coupler.

SECTION 5.0

TEST

5.1 GENERAL

The RAP-200 Repeater Auto Patch is designed for trouble-free, stable operation over a long period of time. The latest in solid-state design plus the selection of ultra-stable components, should provide for an auto patch where no periodic alignment or adjustment is required. Good routine preventive maintenance procedures are required, however, to insure continued reliable operation. If difficulty is experienced in the operation of the unit, however, the following procedure is recommended:

A. If the dual tones are received via a radio system, make sure that the radio equipment, both transmitter and receiver are working properly. Check to be sure that the received tones have no introduced distortion or excessive noise. Check to be sure that the transmitter has the proper amount of deviation or modulation. Be sure that the roll-off of the transmitter's audio circuitry is not attenuating the low or high end of the dual tones.

B. In radio systems where the transmitter is slow to reach full power, be sure that the first digit is held depressed for the proper time interval. When using an automatic dialer or for fast manual dial, allow for system delay times, including the radio system, as well as the pre-determined validation time of attached dial pulse convertors, if used.

C. Check the AC input as well as the output voltage of the RAP-200 power supply.

D. Try to determine if the operational difficulty is within the RAP-200 or the supporting radio system. Substitution of the RAP-200 with a maintenance spare unit known to be operational can determine if the RAP-200 requires maintenance.

E. When it is determined that the RAP-200 requires maintenance, it should be returned to the factory for servicing. Factory maintenance service is performed at no charge on failures which conform to the warranty terms. The warranty is contained in the appendix.

F. If maintenance service for trouble shooting or alignment is desired to be performed on a faulty unit, refer to the following paragraphs:

5.2 TEST EQUIPMENT

The test equipment necessary for testing the RAP-200 is listed below:

DC coupled oscilloscope capable of inspecting wave forms less than 5M Hz.	Inspection of wave form and logic levels
Dual tone generator capable of generating 12 digits	Dual tone signal injection
VOM capable of DC voltage and amperage measurements	To check for proper voltage and current
Frequency counter capable of counting square waves up to 5K Hz.	Tone decoder calibration

5.3 TEST SET UP

Using the test equipment listed, in Paragraph 5.2, perform the tests discussed in the following paragraphs. Most problems encountered with the RAP-200 may be traced to defective integrated circuits or adjustments. The integrated circuits are all mounted in sockets for easy replacements.

5.4 TEST PROCEDURES

Once it has been determined that the RAP-200 is defective, the following tests should point to the defect.

5.5 POWER TEST

With the RAP-200 powered from 116 Vac, measure the DC voltage at the power supply fuse mount on the RPS-1 pwer supply board. The voltage should read +12 Vdc. ±2.0 Vdc. Any shorts on the RAP-200 board will shut the regulators down or blow the associated fuse.

1. Carefully inspect the RAP-200 board for debris that may be shorting it. Use an air hose and clean the board if possible.

2. Check for very warm or hot IC's by touching them. Many times this will isolate the problem.

3. While monitoring the voltage points, carefully remove the IC's, one by one.

5.6 RECEIVE AUDIO AMPLIFIER TEST

5.7 Depress digit three on the dual tone encoder and check the audio level at transformer T3. Release digit 3, the level of audio should drop to zero.

5.8 TONE DECODER TEST

5.9 Inject the digit * into the RAP-200 while observing Pin 8 of U9 and U11. Each pin should go low. Inject the digit # while observing Pin 8 of U9 and U10. Each pin should go low. If trouble is noted, refer to Section 6.0 on alignment.

5.10 DIGIT VALIDATION TEST

5.11 Observe Pin 3 of U8. Send the DTMF digit from the keyboard. Following proper validation timing Pin 3 will go to a low and remain low as long as the individual digit is sent. Release the digit and note that Pin 3 returns to a high.

5.12 CONNECT TEST

5.13 Apply a ground to TB9 or +12 Vdc. to TB15. Send the * digit for a few seconds. Following the termination of the * the auxiliary, PTT and off-hook relays should change state.

5.14 DISCONNECT TEST

5.15 Perform the Connect Test in Paragraph 5.12. Send the # digit, the auxiliary, PTT and off-hook relays sho81d change state.

5.16 TIME OUT TIMER TEST

5.17 Observe Pin 3 of U5. Provide a momentary COR input. Pin 3 should go high. Pin 3 should remain at a high for the duration of the time out function at which time Pin 3 will return to a low.

5.18 TIME OUT TIMER RESET TEST

5.19 Perform the test as stated in Paragraph 5.16. While Pin 3 of U5 is high, provide a steady COR input. Pin 3 should remain at a high for the duration of COR input at which time U5 will time out and Pin 3 will return to a low.

5.20 TELEPHONE AUDIO CLAMP

5.21 Provide a COR input and send the * digit. Monitor phone line audio and note that no audio is present. Release the COR input, wait five seconds and reapply COR input. Audio should now be observed into the phone line.

5.22 TRANSMITTER AUDIO CLAMP

5.23 Monitor transmitter audio. Send tone into telephone coupling transformer T5. No audio should be present. Perform test in Paragraph 5.12. Audio should be present following test 5.12.

5.24 DIAL OUT OSCILLATOR TEST

5.25 Monitor the output of T2. Place a low onto TB3. Audio should be present at the output of T2. NOTE: K1, PTT relay is energized during the audio tone.

5.26 TRANSPONDER AUDIO TEST

5.27 Monitor the output of T2. Perform the test in Paragraph 5.14. Following the test audio should be momentary present at the output of T2. NOTE: K1, PTT relay is energized during the audio tone.

5.28 MONITOR SPEAKER TEST

5.29 Apply audio into telephone cojpling transformer T5. The audio should be monitored via the speaker. Volume is controlled via R3.

5.30 Place a low onto TB1. Front panel connect LED should light. Place a low onto TB2. Front panel connect LED should go out.

SECTION 6.0

ALIGNMENT

6.1 GENERAL

6.2 This section of the RAP-200 manual presents the procedures to be followed to properly align and set up the unit. Refer to the schematic and overlay pictorials given in Section 8 to assist in the alignment. It should be noted that the RAP-200 as received from the factory has been properly aligned and unless misalignment is suspected, further alignment should not be required.

6.3 TONE DECODER INPUT AUDIO ALIGNMENT

6.4 Apply a steady tone of approximately 1000 Hertz or a single tone of 941 or 1209 Hertz to the input of the RAP-200. The amplitude of the tone should be average input of the amplitude to be received during normal interconnect operation. Monitor Pin 3 of U9 with an oscilloscope and adjust R2 for 200 mVpp..

6.5 TONE DECODER CALIBRATION

6.6 With NO audio input signal applied to the input of the RAP-200 observe Pin 5 of each tone decoder U9, U10 and U11. With a frequency counter connected to Pin 5 of each tone decoder, measure the free-running frequency of each tone decoder. Adjust the frequency of each tone decoder to correspond with that shown in Table 6.1.

TONE DECODER	COUNT DESIRED	ADJUST RESISTOR
U9	941	R8
U10	1477	R9
U11	1209	R10

TABLE 6.1

6.7 DIGIT VALIDATION TIMING CALIBRATION

6.8 Depress digit * from the dual tone encoder. Monitor Pin 2 of U8 for a positive going level each time a digit is sent. Using this positive going level as a trigger, observe the output of U8, Pin 3. Pin 3 will go low after the time out of U8. The duration of time required for U8 to time out is the validation time. Capacitor C15, R13 and variable resistor R6 controls the timing of U8. Adjust R6 for the desired validation time in milliseconds.

It should be noted that a fast validation time will cause the decoder to have a tendency to false on some voice signals. A slow validation time greater than 75 milliseconds will insure against voice falsing. It is recommended that at least 100 milliseconds be used for a standard validation time when permitted.

6.9 TIME-OUT TIMER CALIBRATION

6.10 Depress the front panel connect button. Monitor the connect LED for the length of time it is lit after the connect button is released. When the time out timer times out, the connect LED will go out. The time out timer U5 is controlled by capacitor C38, R14 and variable resistor R7. Adjust R7 for the desired time in seconds.

6.11 MOIBLE TO PHONE AUDIO ADJUSTMENT

6.12 With the RAP-200 connected and regular audio level being received from the mobile, adjust the audio to the phone line for proper levels. Adjust R1 for proper output to the phone line.

6.13 PHONE TO TRANSMITTER AUDIO ADJUSTMENT

6.14 With the RAP-200 connected and the regular audio level being received from the phone line, adjust the audio level to the transmitter for proper deviation. Adjust R4 for proper output to the repeater transmitter.

6.15 ACKNOWLEDGMENT TRANSPONDER TO TRANSMIT AUDIO ADJUSTMENT

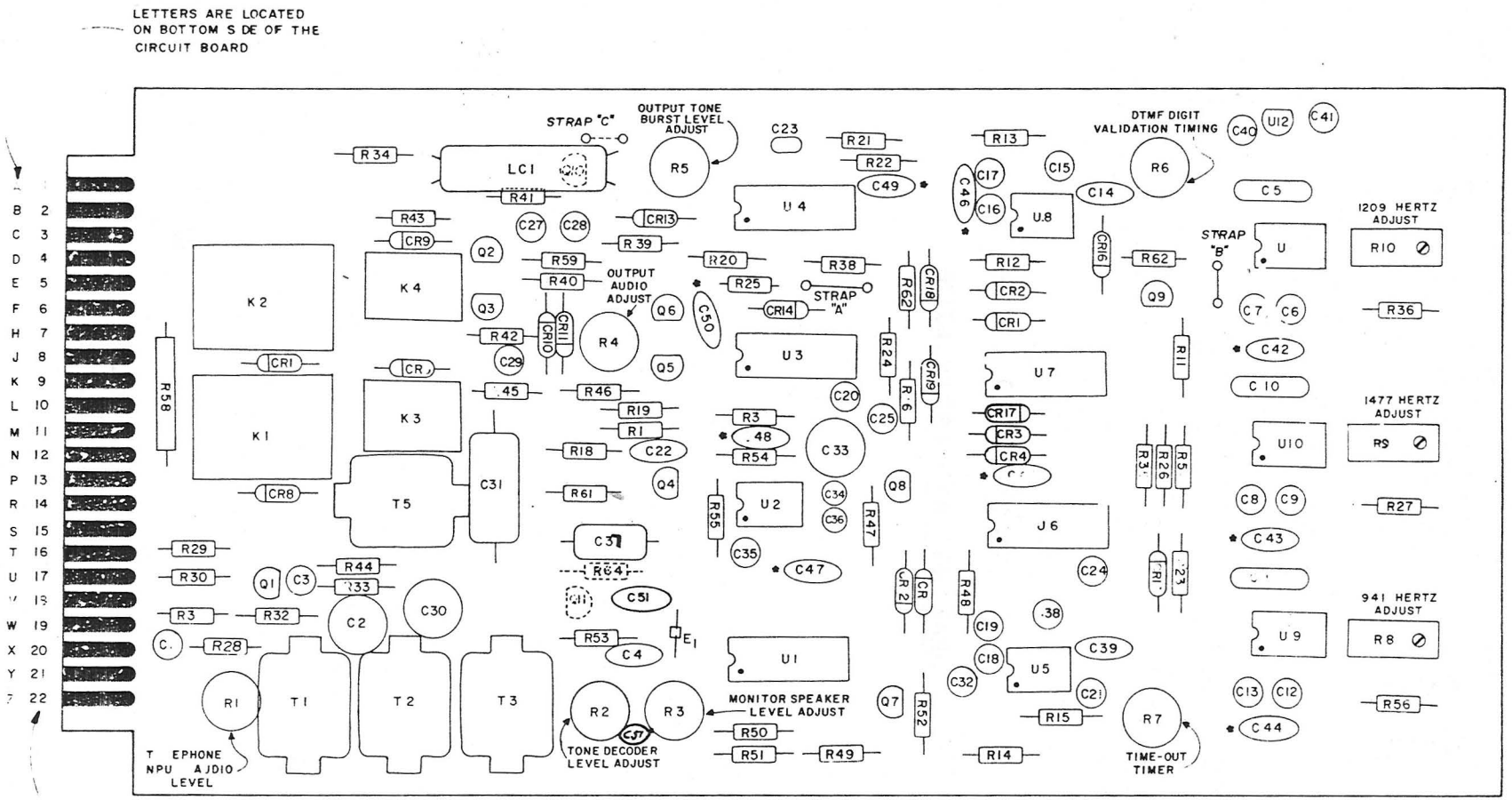
6.16 With the RAP-200 connected, adjust the audio level to the transmitter for proper deviation. Adjust R5 for proper output to the repeater transmitter.

6.17 MONITOR SPEAKER AUDIO ADJUSTMENT

6.18 With normal operation of the RAP-200 under way adjust R3 for the correct level of audio for the self-contained monitor speaker.

SECTION 7.0

DRAWINGS AND PARTS LIST



REVISIONS	
NO.	DATE
	7/25/80
	8-28-80

DATA SIGNAL

COM ONE LOC T
E AT R AUT

NOTES:

1. Unless otherwise indicated:

   All Diodes are 1N4148
   All Resistors are in ohms, 5%, 1/4 watt
   All capacitance values are in microfarads

2. Types of capacitors shown are:

   C = Ceramic
   M = Mylar
   P = Polycarborate
   T = Tantalum
   E = Electrolytic

3. All → > designation, refer to card connector

4. All ○ designation, refer to panel terminal strip

5. All □ designation, refer to power supply

PHONE LINE

OFF HOOK

TRANSMITTER AUDIO

COMMON (SELECTED)

CONNECT

L.E.D.

PTT RELAY

AUXILIARY RELAY

BY-PASS CAPACITORS

NORMAL OPERATING POSITION

OFF HOOK AUDIO CLAMP

OUTPUT AUDIO LEVEL ADJUST

OUTPUT TONE BURST LEVEL ADJ.

NON-ACTIVITY TIME OUT TIMER

DTMF DIGIT VALIDATION TIMING

REMOTE CONNECT

REMOTE DISCONNECT

MONITOR SPEAKER LEVEL ADJUST

SPEAKER

COR POSITIVE VOLTAGE INPUT

COR GROUND INPUT

RINGING VOLTAGE (LOW VOLTAGE)

RINGING VOLTAGE (HIGH VOLTAGE)

RINGING VOLTAGE (HIGH VOLTAGE)

1209 HERTZ ADJUST

1477 HERTZ ADJUST

941 HERTZ ADJUST

TONE DECODER LEVEL ADJUST

TELEPHONE INPUT AUDIO LEVEL

RECEIVER AUDIO SPEAKER

+12 VDC. INPUT

SEE PARAGRAPH 5.55

STRAP "A"

STRAP "B"

STRAP "C" (OPTIONAL)

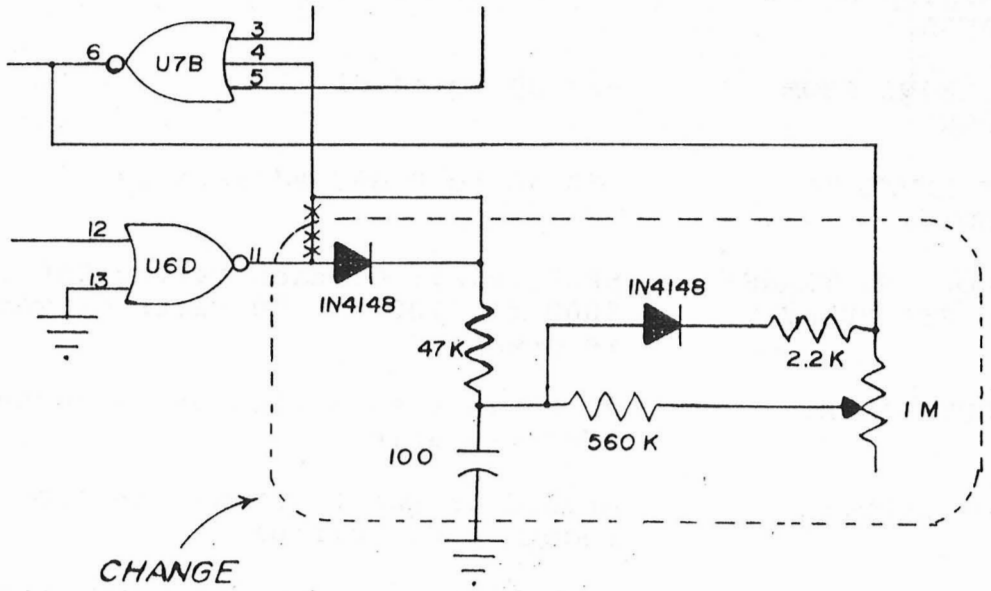
Q10 (OPTIONAL)

Q11 (OPTIONAL)

REVISIONS			DATA SIGNAL, INC.
NO.	DATE	BY	SCHEMATIC DIAGRAM
1	8-29-80		RAP-200
2	10-17-80		
DRAWN BY TM	SCALE	MATERIAL	
DATE 7-9-79		DRAWING NO. DS-262-0129	

ENGINEERING UPDATE

The following Engineering Update has been performed on your interconnect package. Please place this change notice within your manual.



The addition of the above circuitry permits the interconnect to time out after a preset time, usually three minutes, following the off hook condition.

SAI-800 MANUAL

RAP-200 MANUAL

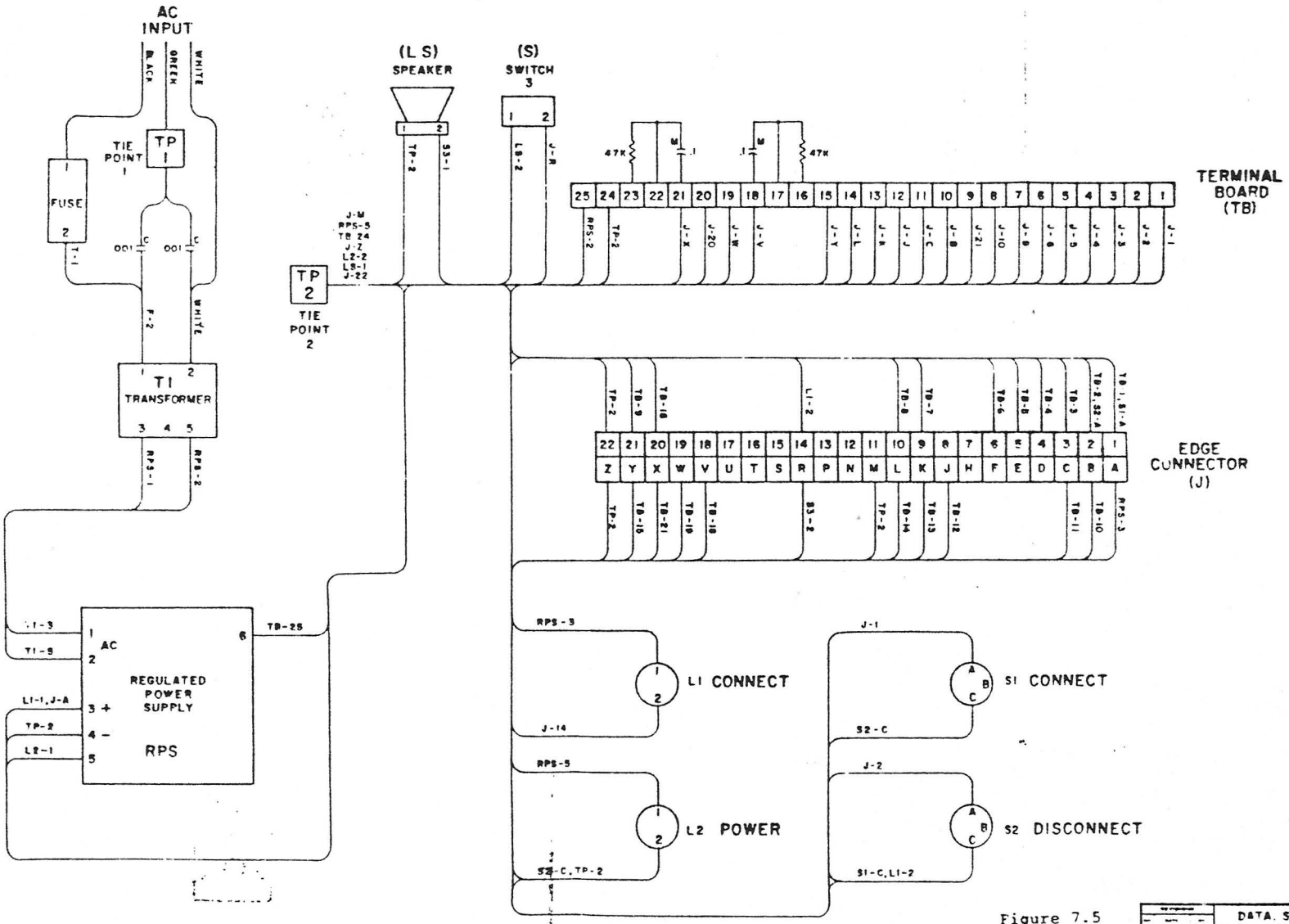
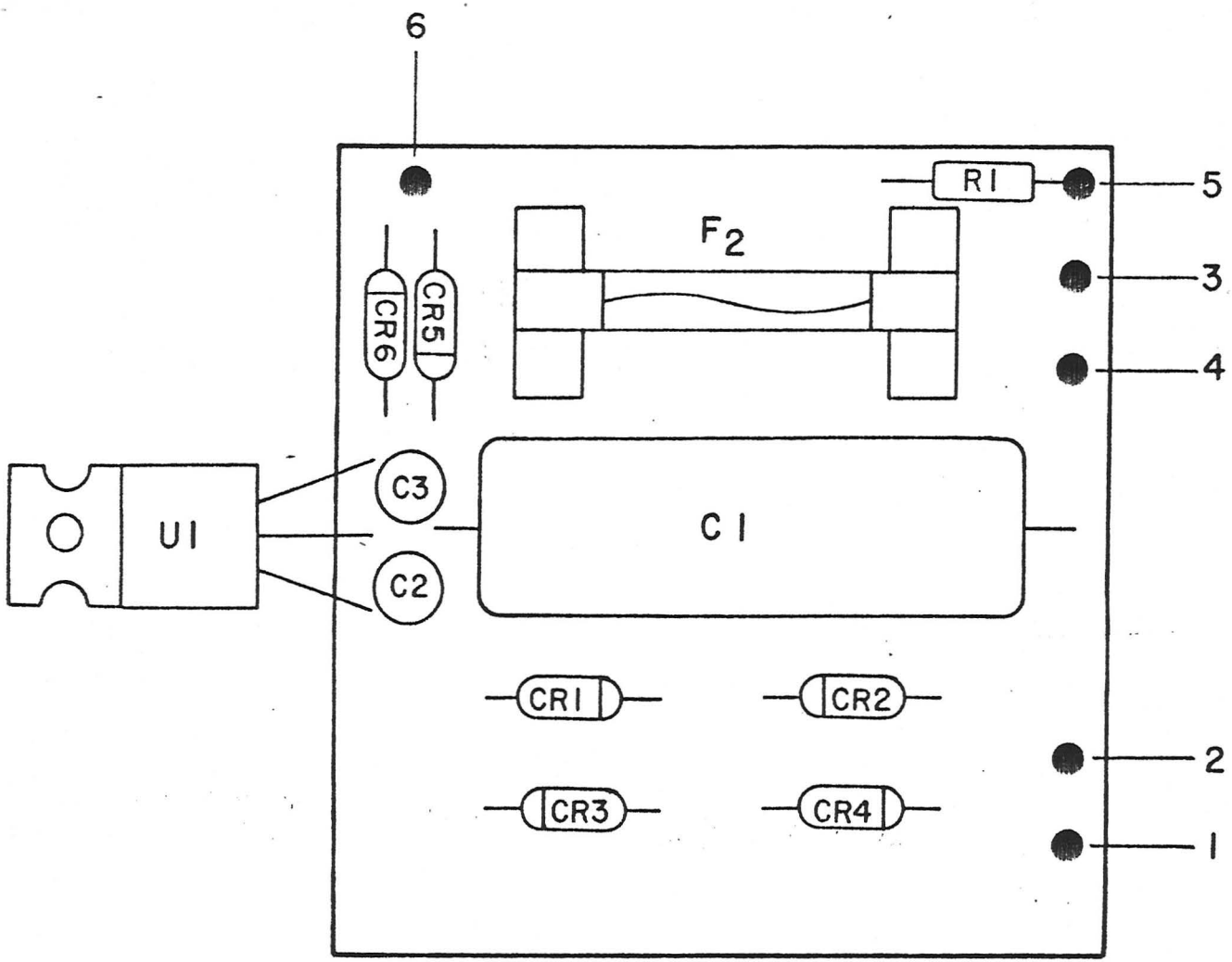


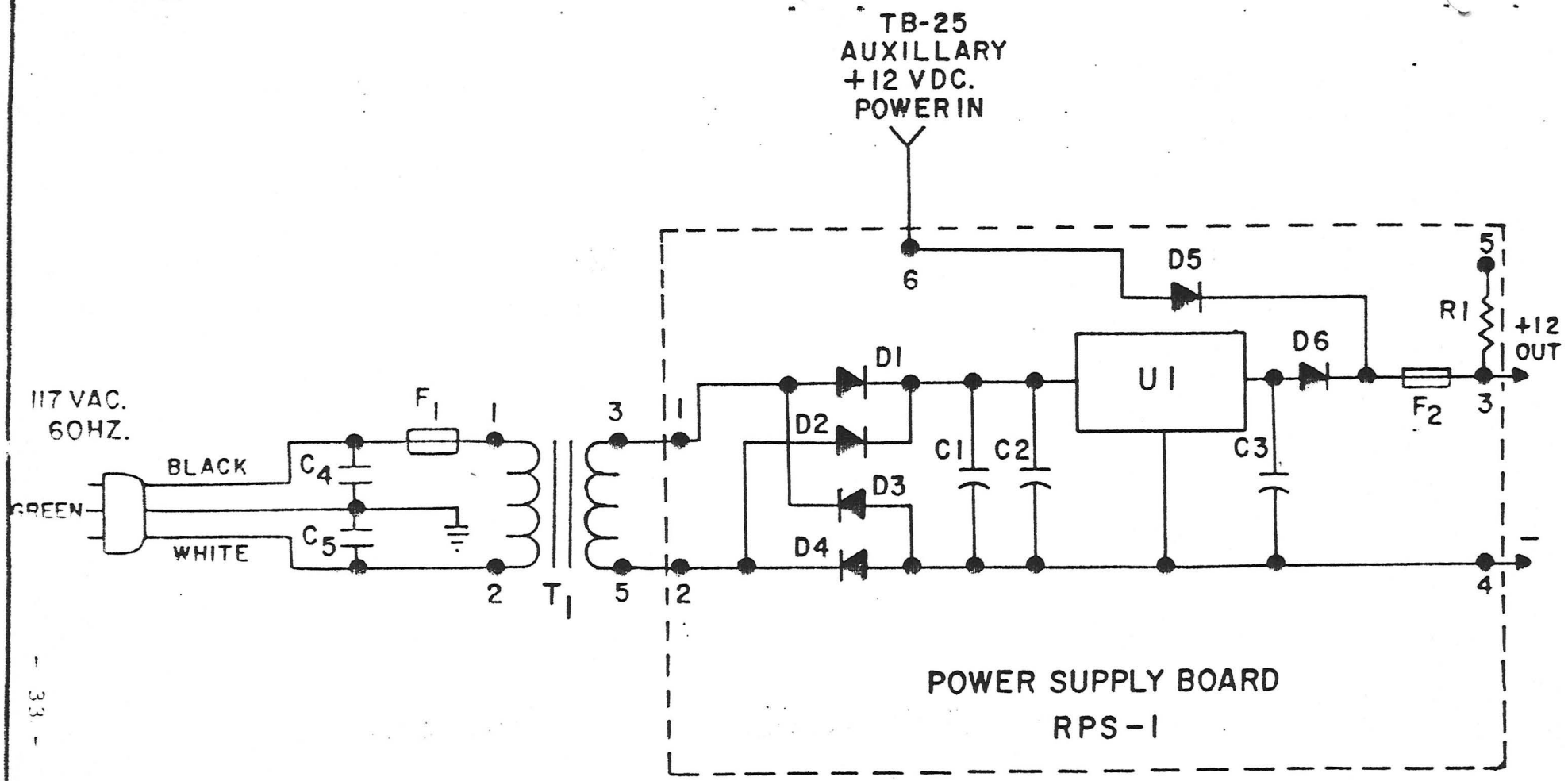
Figure 7.5

DATA SIGNAL INC
REPEATER AUTO PATCH 200
WIRING DIAGRAM



POWER SUPPLY BOARD

DATA SIGNAL, INC.		
COMPONENT LOCATION —— RPS I		
DRAWN BY TM	SCALE ~	MATERIAL
CHK'D RL	DATE 7-19-79	DRAWING NO. DS-262-0312
TRACED	APP'D LWQS	



NOTE:

C1	1000MFD., 35VDC.
C2	1MFD., 35VDC.
C3	10MFD., 16VDC.
C4,5	.001MFD., 1000VDC.
D1-6	IN4001
R1	600Ω
F1	1/2 AMPERE
F2	1/3 AMPERE
T1	117 VAC./24 VCT.
U1	7812, +12 VOLT REGULATOR

DATA SIGNAL, INC.		
SCHEMATIC – +12VDC. POWER SUPPLY		
DRAWN BY TM	SCALE ~	MATERIAL
CHK'D CL	DATE 7-19-79	DRAWING NO. DS-262-0301
TRACED	APP'D WQS	

PARTS LIST

SYMBOL	COMPONENTS	TYPE	DATA SIGNAL STOCK NUMBER
CAPACITORS:			
C1,6,9,12,27,28	2.2 mfd. @ 16V	Tantalum	181-0013
C2, 30, 33	100 mfd. @ 16V	Electrolytic	188-0018
C3, 29	33 mfd. @ 10V	Tantalum	181-0017
C4, 22	0.1 mfd. @ 12V	Ceramic	180-0017
C5, 10, 11	0.1 mfd. @ 50V	Poly-Carbonate	184-0011
C7,8,13,20,40,41	4.7 mfd. @ 16V	Tantalum	181-0014
C14,21,39,42-50	0.01 mfd. @ 16V	Ceramic	180-0014
C15	0.47 mfd. @ 16V	Tantalum	181-0011
C16,18,36	0.1 mfd. @ 16V	Tantalum	181-0010
C17,19,32,35	10 mfd. @ 16V	Tantalum	181-0015
C23	0.01 mfd. @16V	Mylar	182-0011
C24, 34	1 mfd. @16V	Tantalum	181-0012
C31	4 mfd. @ 50V	Non Polar	187-0013
C37	47 mfd. @ 10V	Electrolytic	188-0016
C38	15 mfd. @ 16V	Tantalum	181-0016
DIODES:			
CR-1 - 16	1N4148	Silicon Signal	161-0010
INTEGRATED CIRCUITS:			
U1, 3, 4, 6	4001	Quad NOR	151-0014
U2	LM 386	Audio Amplifier	152-0013
U5, 8	555	Timer	152-0014
U9, 10, 11	567	Tone Decoder	152-0016
U12	78L05	5-Volt Regulator	152-0040
U7	4025	Triple 3-Input NOR	50-4025

SYMBOL	COMPONENT	TYPE	DATA SIGNAL STOCK NUMBER
RESISTORS:			
R1, 4, 5	50K ohm	Variable	130-0019
R2	20K ohm	Variable	130-0018
R3	10K ohm	Variable	130-0017
R6	250K ohm	Variable	130-0021
R7	5M ohm	Variable	130-0024
R8, 9, 10	5K ohm	Multi-Turn Variable	130-0036
R11,12,13,18, 19,20,26,28, 30, 32,35,40,41,43,45, 47,53,56,57,59	10K ohm, ¼ W, 5%	Carbon Film	120-1002
R14, 38, 39	1M ohm, ¼ W, 5%	Carbon Film	120-1004
R15, 31	1K ohm, ¼ W, 5%	Carbon Film	120-1001
R16,17,21,24, 25,34,37	47K ohm, ¼ W, 5%	Carbon Film	120-4702
R22	470K ohm, ¼ W, 5%	Carbon Film	120-4703
R23	47 ohm, ¼ W, 5%	Carbon Film	120-0470
R27, 51	5.6K ohm, ¼ W, 5%	Carbon Film	120-5601
R29,42,48,49	2.2K ohm, ¼ W, 5%	Carbon Film	120-2201
R33, 44	120 ohm, ¼ W, 5%	Carbon Film	120-1200
R36	8.2K ohm, ¼ W, 5%	Carbon Film	120-8201
R46	680 ohm, ¼ W, 5%	Carbon Film	120-6800
R50	4.7K ohm, ¼ W, 5%	Carbon Film	120-4701
R52	100K ohm, ¼ W, 5%	Carbon Film	120-1003
R54	270 ohm, ¼ W, 5%	Carbon Film	120-2700
R55	1.2K ohm, ¼ W, 5%	Carbon Film	120-1201
R58	820 ohm, 1 W, 10%	Carbon Comp.	121-8201
TRANSISTORS:			
Q1 - 9	AT2222	NPN	171-0010

LIMITED WARRANTY

Data Signal, Inc., warrants each new product sold to be free from defective material and workmanship for a period of one year from date of shipment and agrees to repair any such defect or to furnish a new part of any unit which under normal installation, use, and service, discloses such defect. The original owner of the unit or part must return the merchandise freight prepaid to Data Signal and provided that an examination discloses in our judgement that it is defective, and the unit or part is approved by us for repair or exchange hereunder, the unit or part will be repaired or exchanged by Data Signal, Inc. without charge to the owner. This warranty is in lieu of all other warranties expressed or implied and no representative or persons is authorized to assume for us any other liability in connection with sale of our products.

All warranty repairs must be performed by Data Signal, Inc. No credit will be allowed for repair work attempted by the customer. Data Signal will return, freight prepaid, the repaired or replaced equipment to purchaser, within the Continental United States. Equipment found NOT to be defective will be returned at purchaser's expense and shall include cost of handling, testing and returning of equipment.

Equipment for repair may be returned to the factory without prior written authorization. It is required, however, that a brief description of the defect be included with the equipment.

Out-of-warranty repairs will be billed at the rate of $35.00 per hour, plus components needed for replacement.

Excepted from this one-year warranty are the SME encoders, DTMF series encoders and the Data-Coder series of microphones which carry a 90-day warranty from date of shipment. Batteries are not included in the Limited Warranty.

This warranty does not extend to any of our products which have been subjected to misuse, accident, incorrect wiring not our own, improper installation, or used in violation of the instructions furnished by us, and does not extend to units which have been repaired or altered outside of our factory. It does not extend to damage incurred by natural causes such as lightening, fire, floods, or other such catastrophes, nor to damage caused by environmental extremities, such as power surges and/or transients.

Data Signal, Inc. reserves the right to make any improvements to its products which it may deem desirable without obligation to install such improvements in its previously sold products.

DATA SIGNAL, INC. 2403 COMMERCE LANE ALBANY, GA 31708 (912) 883-4703

2403 COMMERCE LANE ALBANY, GEORGIA 31706

Tone Encoding–Decoding at its BEST

EXCITING NEW PRODUCTS

RAP-200

A Complete Autopatch facility that requires only a repeater and a telephone line. Features include single-digit access/disconnect, direct dialing from mobile or hand-held radios, adjustable amplifiers for transmitter and telephone audio, and tone-burst transponder for acknowledgement of patch disconnect.

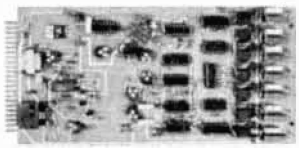
RAP-200 P. C. Card $199.50
RAP-200R Rack Mount $249.50

RAP-400

A complete Autopatch facility, similar to the RAP-200, that additionally provides for half- or full-duplex operation and features built-in compression amplifiers plus a long-distance inhibit function on digits 1 and 0.

RAP-400 $749.00

DATA TONE TO DIAL PULSE CONVERTER



The Data Tone to Dial Pulse converter Model DPC-221 provides full compatibility between Touch-Tone* encoders and rotary dial-pulse telephone exchanges. Two separate outputs for the * and # digits provide remote control operation, and a cancel function permits the caller to automatically stop and reset the converter's dialing circuits.

DPC-221 P. C. Board $219.00
DPC-221R Rack Mount $299.00

SME

SUB-MINIATURE TOUCH TONE ENCODERS

MODEL SME — Smallest available Touch Tone Encoder. Thin, only .05" thick, keyboard mounts directly to front of hand-held portable, while sub-miniature tone module fits inside. This keyboard allows use of battery chargers. Price $34.50, with your choice of keyboards.

MIGHTY MOS

Complete C-MOS keyer, versatile controls allow wide character-weight variations, speeds from 5- to 50-wpm plus volume and tone control. Solid state output switching transistors are compatible with both grid-block and solid-state transmitters. Unit also available in kit and wired p. c. board only versions.

MIGHTY MOS $39.50
P. C. Card - Wired $24.95
P. C. Card - Kit $19.95

DTM

MODEL DTM — Completely self-contained miniature encoder for hand-held portables. Only 5/16" thick. Three wire connection. Automatic PTT keying optional. With your choice of keyboards. **Price: DTM - $49.50, DTM-PTT - $59.50.**

TTP-1

TTP-2

UNIVERSAL TOUCH-TONE ENCODERS

The Data Signal TTP Series of keyboard encoders is used to generate the standard 12 or 16 DTMF digits. The encoders provide fully automatic transmitter keying and feature a delayed **Transmit Ready** light, an interdigit timer, and a built-in audio monitor. Features also include all solid-state, crystal-controlled, digitally-synthesized tones and an optional internal mount Automatic Number Identifier (ANI).

TTP-1 (12-digit) $59.00
TTP-2 (16-digit) $69.00

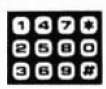
*Touch-Tone is a registered trade name of AT&T.

DATA SIGNAL AND DIGITRAN KEYBOARDS

Style A — 2¼" x 3"

Style B — 1⅝" x 2⅛"

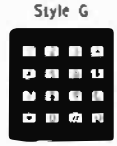
Style C — 2⅛" x 1⅝"



Style D — 2⅛" x 2⅛"

Style F — 2" x 2 11/16"

Style G — 2½" x 2 11/16"



Ask About Our Deluxe Receiver Preamplifier For HF & VHF
and
Send For Free New Catalog

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master charge

More Details? CHECK—OFF Page 150

REPEATER USERS — *Stay in Touch* — with DSI

UNIVERSAL TOUCH-TONE® ENCODERS

The Data Signal TTP Series of keyboard encoders is used to generate the standard 12 or 16 DTMF digits. The encoders provide fully automatic transmitter keying and feature a delayed **Transmit Ready** light, an interdigit timer, and a built-*in audio monitor. Features also include all solid-state, crystal*-controlled, digitally-synthesized tones and an optional internal mount Automatic Number Identifier (ANI).

TTP-1 (12-digit) **$59.00**
TTP-2 (16-digit) **$69.00**

MODEL DTM — Completely self-contained miniature encoder for hand-held portables. Only 5/16" thick. Three wire connection. Automatic PTT keying optional. With your choice of keyboards. **Price DTM - $39.00, DTM-PTT - $49.00.**

*Touch-Tone is a registered trade name of AT&T.

TTP-1

DTM

TTP-2

SUB-MINIATURE ENCODERS

MODEL SME — Smallest available Touch Tone Encoder. Thin, only .05" thick, keyboard mounts directly to front of hand-held portable, while sub-miniature tone module fits inside. This keyboard allows use of battery chargers. **Price $29.00,** with your choice of keyboards. **SME** (less keyboard) **$24.00**

AUTOPATCH — Ready to go!

A Complete Autopatch facility that requires only a repeater and a telephone line. Features include single-digit access/disconnect, direct dialing from mobile or hand-held radios, adjustable amplifiers for transmitter and telephone audio, and tone-burst transponder for acknowledgement of patch disconnect.

RAP-200 P. C. Card **$199.50**
RAP-200R Rack Mount **$249.50**

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Be sure to ask about our new keyers and CW memory for CW buffs.

More Details? CHECK—OFF Page 142

HAND HOLDING? . . . LET

DATA SIGNAL *put rings on your fingers . . .*

with our SUB-MINIATURE ENCODERS

The world's smallest hand-held goes hand-in-hand with the world's smallest, lightest and least expensive T-T Pads.

MODEL SME — Smallest available Touch Tone Encoder. Thin, only .05" thick, keyboard mounts directly to front of hand-held portable, while sub-miniature tone module fits inside. This keyboard allows use of battery chargers. **Price $29.00,** with your choice of keyboards. **SME** (less keyboard) **$24.00**

SME

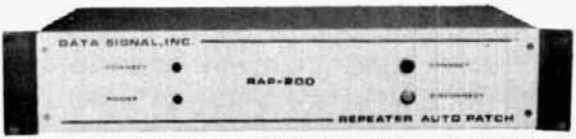
DTM **or,**

MODEL DTM — Completely self-contained miniature encoder for hand-held portables. Only 5/16" thick. Three wire connection. Automatic PTT keying optional. With your choice of keyboards. **Price DTM - $39.00, DTM-PTT - $49.00.**

*Touch-Tone is a registered trade name of AT&T.

. . . *And Bells on Your Toes*

with our AUTOPATCH — Ready to go!



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